500.34077CC3

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants: Atsushi MAKI *et al.*

Serial No.: Unassigned (§53b Continuation of 09/203,610 filed 2 December 1998)

Filed: 9 July 2001

For: OPTICAL SYSTEM FOR MEASURING METABOLISM IN A BODY AND IMAGING METHOD

Art Unit: Unassigned (Parent - 3737)

Examiner: Unassigned (Parent - E. Mantis Mercader)

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents
Washington, D.C. 20231

9 July 2001

Sir:

Prior to calculating the filing fee for the above-identified continuation application, the follow amendments and remarks are respectfully submitted.

IN THE SPECIFICATION:

Please amend the specification as follows.

Page 1 of the English-language specification, before the section heading "BACKGROUND OF THE INVENTION," please add the following new section.

--**CROSS-REFERENCE TO EARLIER APPLICATIONS**

This application is a continuation of U.S. Serial No. 09/203,610 filed 2 December 1998, now allowed, which is a continuation of U.S. Serial No. 09/149,155 filed 8 September 1998, now U.S. Patent No. 6,128,517, which is a

continuation of U.S. Serial No. 08/539,871 filed 6 October 1995, now U.S. Patent No. 5,803,909.--

Please amend the paragraph bridging pages 4 and 5 of the English-language specification (page 4, line 27 through page 5, line 9) as follows.

--(Second Problem)

It has hitherto been known to optically measure the cerebral cortex under the skull with an optical spot by means of a light generating and receiving element and a fiber, but measurement of an image of a hemodynamic state covered with the protective tissues such as skin tissues and bone tissues, that is, measurement with a plurality of measuring points, has been neither disclosed nor suggested.--

IN THE CLAIMS:

Please cancel original claims 1-27 without prejudice or disclaimer.

Please amend Claims 30, 31 and 33-38 as follows.

30.(Once Amended) A living body optical measurement system according to claim 28, comprising a logarithmic amplifier and a differential amplifier, wherein the light detection signal is logarithmically amplified and then a logarithmic difference signal is generated by the differential amplifier.

31.(Once Amended) A living body optical measurement system according to claim 28, wherein said light irradiation means includes an optical fiber for connecting

the light source and the light irradiation position, and said light detection means includes an optical fiber for connecting a photodetector and the light detection position.

33.(Once Amended) A living body optical measurement system according to claim 28, comprising a light irradiation position, a first detection position, a second detection position, a third detection position set on a half line extending from its origin at the light irradiation position to pass through the first detection position, and a fourth detection position set on a half line extending from its origin at the light irradiation position to pass through the second detection position, wherein a logarithmic difference signal (first logarithmic difference signal) between light detection signals detected at said first and third detection positions and a logarithmic difference signal (second logarithmic difference signal) between transmitting light intensity levels detected at said second and fourth detection positions are measured, and a difference signal between said first and second logarithmic difference signals is measured.

34.(Once Amended) A living body optical measurement system according to claim 28, comprising:

first light irradiation means for irradiating light on the surface of the living body;

first irradiation light intensity detection means for detecting the irradiation light intensity from said first light irradiation means;

second light irradiation means for irradiating light on the surface of the living body;

second irradiation light intensity detection means for detecting the irradiation light intensity from said second light irradiation means;

light detection means for detecting the intensity of light attributable to said first light irradiation means or said second light irradiation means and transmitting through the interior of the living body so as to go out of the surface of the living body;

means for generating a logarithmic difference signal (first logarithmic difference signal) between an output of said first irradiation light intensity detection means and an output of said light detection means attributable to said first light irradiation means;

means for generating a logarithmic differences signal (second logarithmic difference signal) between an output of said second irradiation light intensity detection means and an output of said light detection means attributable to said second light irradiation means; and

means for measuring a difference signal between said first and second logarithmic difference signals.

35.(Once Amended) A living body optical measurement system according to claim 28, wherein irradiation light from said light irradiation means is modulated in intensity, and only a frequency component of the detection signal from said light detection means which equals a frequency for the intensity modulation is extracted for use by a lock-in amplifier or through a Fourier transform processing.

36.(Once Amended) A living body optical measurement system according to claim 28, wherein the number m of wavelengths of irradiation light equals the number n of light irradiation positions, and n×m kinds of intensity modulation frequencies for the light source are used.

37.(Once Amended) A living body optical measurement method using the living body optical measurement system as recited in claim 28, wherein measurement is carried out by setting the light irradiation position and the light detection positions on the surface of the living body such that a signal from a region where extinction characteristics changes locally on the basis of a change in hemodynamic movement in the living body is contained in a light intensity signal detected at at least one light detection position but is not contained in a light intensity signal detected at at least another light detection position.

38.(Once Amended) A living body optical measurement system according to claim 28, wherein after a logarithmic difference signal between different sites of detection position is so adjusted as to be zero under the condition that the change does not occur at the region where extinction characteristics changes locally in the living body, measurement is started and a displacement value of the difference signal is used as the measured signal.

Please add new claims 39-46, as follows.

39.(New) A living body optical measurement system according to claim 29, comprising a logarithmic amplifier and a differential amplifier, wherein the light detection signal is logarithmically amplified and then a logarithmic difference signal is generated by the differential amplifier.

40.(New) A living body optical measurement system according to claim 29, wherein said light irradiation means includes an optical fiber for connecting the light source and the light irradiation position, and said light detection means includes an optical fiber for connecting a photodetector and the light detection position.

41.(New) A living body optical measurement system according to claim 29, comprising a light irradiation position, a first detection position, a second detection position, a third detection position set on a half line extending from its origin at the light irradiation position to pass through the first detection position, and a fourth detection position set on a half line extending from its origin at the light irradiation position to pass through the second detection position, wherein a logarithmic difference signal (first logarithmic difference signal) between light detection signals detected at said first and third detection positions and a logarithmic difference signal (second logarithmic difference signal) between transmitting light intensity levels detected at said second and fourth detection positions are measured, and a difference signal between said first and second logarithmic difference signals is measured.

42.(New) A living body optical measurement system according to claim 29, comprising:

first light irradiation means for irradiating light on the surface of the living body;

first irradiation light intensity detection means for detecting the irradiation light intensity from said first light irradiation means;

second light irradiation means for irradiating light on the surface of the living body;

second irradiation light intensity detection means for detecting the irradiation light intensity from said second light irradiation means;

light detection means for detecting the intensity of light attributable to said first light irradiation means or said second light irradiation means and transmitting through the interior of the living body so as to go out of the surface of the living body;

means for generating a logarithmic difference signal (first logarithmic difference signal) between an output of said first irradiation light intensity detection means and an output of said light detection means attributable to said first light irradiation means;

means for generating a logarithmic differences signal (second logarithmic difference signal) between an output of said second irradiation light intensity detection means and an output of said light detection means attributable to said second light irradiation means; and

means for measuring a difference signal between said first and second logarithmic difference signals.

43.(New) A living body optical measurement system according to claim 29, wherein irradiation light from said light irradiation means is modulated in intensity, and only a frequency component of the detection signal from said light detection means which equals a frequency for the intensity modulation is extracted for use by a lock-in amplifier or through a Fourier transform processing.

44.(New) A living body optical measurement system according to claim 29, wherein the number m of wavelengths of irradiation light equals the number n of light irradiation positions, and n×m kinds of intensity modulation frequencies for the light source are used.

45.(New) A living body optical measurement method using the living body optical measurement system as recited in claim 29, wherein measurement is carried out by setting the light irradiation position and the light detection positions on the surface of the living body such that a signal from a region where extinction characteristics changes locally on the basis of a change in hemodynamic movement in the living body is contained in a light intensity signal detected at at least one light detection position but is not contained in a light intensity signal detected at at least another light detection position.

46.(New) A living body optical measurement system according to claim 29, wherein after a logarithmic difference signal between different sites of detection position is so adjusted as to be zero under the condition that the change does not

occur at the region where extinction characteristics changes locally in the living body, measurement is started and a displacement value of the difference signal is used as the measured signal.

IN THE ABSTRACT:

Please delete the Abstract filed with the application, and enter the following replacement Abstract therefor.

--ABSTRACT OF THE DISCLOSURE

In an optical measurement system and imaging method adapted to measure *in vivo* information in a living body without harming the living body, light rays of a plurality of wavelengths which are modulated in intensity with a plurality of different frequencies are irradiated on a plurality of irradiation positions on the surface of a living body, and time-variable changes in living body transmitting light intensity levels corresponding to the respective wavelengths and the respective irradiation positions are measured at different positions on the surface of the living body. Light is utilized to image the results of the measurements, in which the measuring time is shortened by estimating fluctuation attributable to the living body, and the presence or absence of a change in measured signal can be decided easily by displaying an estimation signal and a measured signal at a time.--

REMARKS

This paper is to submit preliminary amendments and data in the continuation application indicated above, and is responsive in any manner indicated below.

Pending Claims

Unrelated to any prior art rejection, original Claims 1-27 have been cancelled without prejudice or disclaimer. Claims 30, 31 and 33-38 have been amended only to remove the multiple dependency in those claims, and new Claims 39-46 are added to reintroduce only the subject matter cancelled with the multiple dependency. Therefore, Claims 28-46 are pending for consideration and examination in the present continuation application.

Application Papers

Attached are a true copy of the Japanese-language application and drawings filed in prior application Serial No. 08/539,871, and a true copy of the verified English-language translation filed therefor. The English-language translation comprises all the necessary requirements for the present continuation application.

Examiner Interview and Supplemental Preliminary Amendment

An Examiner Interview prior to first Office Action in this continuing or substitute application is respectfully requested. As stated in MPEP §713.02, "A request for an interview prior to first Office Action is ordinarily granted in continuing or substitute applications." Similarly, as stated in MPEP §706.07(b), "A request for

an interview prior to first action on a continuing or substitute application should ordinarily be granted." Applicants intend to file a Supplemental Preliminary Amendment to submit additional claims that should be examined in this application, and would appreciate the benefit of such an Examiner Interview prior to the filing of such a the Supplemental Preliminary Amendment. The Examiner is respectfully requested to contact the attorney indicated on this paper at the local Washington, D.C. area telephone number of 703-312-6600 for the purpose of scheduling an Examiner Interview, and is thanked in advance for such considerations. Contact also will be attempted by the undersigned attorneys to schedule an Examiner Interview.

Information Disclosure Statement

Filed concurrently herewith is an Information Disclosure Statement (IDS) and Form PTO-1449 to submit the information cited to and by the Office in prior applications. The IDS is being filed so the information listed on the Form PTO-1449 is considered in the present continuation application and appears on the printed face of any patent issuing hereon.

Claim for Priority

Applicants claim priority under 35 USC §119 of Japanese Patent Publications No. 06-242592 filed 6 October 1994, No. 07-030972 filed 20 February 1995 and No. 07-169820 filed 5 July 1995. The certified copies of the priority documents were filed in prior application Serial No. 08/593,871, upon which benefit is claimed under 35

USC §120. Further, verified English-language translations of the priority documents were filed in parent application Serial No. 09/203,610 on 16 November 2000. Applicants courteously request written confirmation of perfection of the claim for foreign priority in the present application.

Assignee of Entire Interest

HITACHI, LTD. is Assignee of entire right, title and interest in and to the present application by virtue of an Assignment dated 28 September 1995 filed in prior application 08/539,871 and recorded 6 October 1995 at Reel 7767, Frames 0678-0680.

Specific Reference to Earlier-Filed Applications

The specification has been amended to incorporate specific reference to a prior U.S. application upon which benefit of an earlier filing date is claimed.

Drawings

A Letter to the Official Draftsperson is being filed concurrently herewith to submit twenty-one (21) sheets of formal drawings for Figures 1-23.

Examiner Invited To Telephone

The Examiner is herein invited to telephone the undersigned attorneys at the local Washington, D.C. area telephone number of 703/312-6600 for discussing any

Examiner's Amendments or other suggested actions for accelerating prosecution and moving the present application to allowance.

Conclusion

Applicants respectfully request notice of the early allowance of the present application.

This Preliminary Amendment is being filed with the present continuation application, and therefore, no Petition or extension of time is necessary. Please charge any shortage in the fees due in connection with the filing of this paper, including excess claim fees, to ATS&K Deposit Account No. 01-2135 (referencing case No. 501.35760CC3), and please credit any excess fees to such Deposit Account.

Respectfully submitted,

Paul J. Skwierawski
Registration No. 32,173
ANTONELLI, TERRY, STOUT & KRAUS, LLP
1300 North Seventeenth Street, Suite 1800
Arlington, VA 22209
Telephone 703-312-6600
Facsimile 703-312-6666

ATTACHMENT:
- Appendix A-Marked Version

APPENDIX A-MARKED VERSION

Specification:

Paragraph bridging pages 4 and 5 of the English-language specification:

(Second Problem)

It has hitherto been known to optically measure the cerebral cortex under the skull with an optical spot by means of a light generating and receiving element and a fiber, but measurement of an image of a hemodynamic state covered with the protective tissues such as skin tissues and bone tissues, that is, measurement with a plurality of measuring points, has been neither disclosed nor suggested.

Claims:

30.(Once Amended) A living body optical measurement system according to claim 28 [or 29], comprising a logarithmic amplifier and a differential amplifier, wherein the light detection signal is logarithmically amplified and then a logarithmic difference signal is generated by the differential amplifier.

31.(Once Amended) A living body optical measurement system according to claim 28 [or 29], wherein said light irradiation means includes an optical fiber for connecting the light source and the light irradiation position, and said light detection means includes an optical fiber for connecting a photodetector and the light detection position.

33.(Once Amended) A living body optical measurement system according to claim 28 [or 29], comprising a light irradiation position, a first detection position, a second detection position, a third detection position set on a half line extending from its origin at the light irradiation position to pass through the first detection position, and a fourth detection position set on a half line extending from its origin at the light irradiation position to pass through the second detection position, wherein a logarithmic difference signal (first logarithmic difference signal) between light detection signals detected at said first and third detection positions and a logarithmic difference signal (second logarithmic difference signal) between transmitting light intensity levels detected at said second and fourth detection positions are measured, and a difference signal between said first and second logarithmic difference signals is measured.

34.(Once Amended) A living body optical measurement system according to claim 28 [or 29], comprising:

first light irradiation means for irradiating light on the surface of the living body;

first irradiation light intensity detection means for detecting the irradiation light intensity from said first light irradiation means;

second light irradiation means for irradiating light on the surface of the living body;

second irradiation light intensity detection means for detecting the irradiation light intensity from said second light irradiation means;

light detection means for detecting the intensity of light attributable to said first light irradiation means or said second light irradiation means and transmitting through the interior of the living body so as to go out of the surface of the living body;

means for generating a logarithmic difference signal (first logarithmic difference signal) between an output of said first irradiation light intensity detection means and an output of said light detection means attributable to said first light irradiation means;

means for generating a logarithmic differences signal (second logarithmic difference signal) between an output of said second irradiation light intensity detection means and an output of said light detection means attributable to said second light irradiation means; and

means for measuring a difference signal between said first and second logarithmic difference signals.

35.(Once Amended) A living body optical measurement system according to claim 28 [or 29], wherein irradiation light from said light irradiation means is modulated in intensity, and only a frequency component of the detection signal from said light detection means which equals a frequency for the intensity modulation is extracted for use by a lock-in amplifier or through a Fourier transform processing.

36.(Once Amended) A living body optical measurement system according to claim 28 [or 29], wherein the number m of wavelengths of irradiation light equals the

number n of light irradiation positions, and n×m kinds of intensity modulation frequencies for the light source are used.

37.(Once Amended) A living body optical measurement method using the living body optical measurement system as recited in claim 28 [or 29], wherein measurement is carried out by setting the light irradiation position and the light detection positions on the surface of the living body such that a signal from a region where extinction characteristics changes locally on the basis of a change in hemodynamic movement in the living body is contained in a light intensity signal detected at at least one light detection position but is not contained in a light intensity signal detected at at least another light detection position.

38.(Once Amended) A living body optical measurement system according to claim 28 [or 29], wherein after a logarithmic difference signal between different sites of detection position is so adjusted as to be zero under the condition that the change does not occur at the region where extinction characteristics changes locally in the living body, measurement is started and a displacement value of the difference signal is used as the measured signal.

Abstract:

ABSTRACT OF THE DISCLOSURE

In an optical measurement system and imaging method adapted to measure *in vivo* information in a living body without harming the living body, [Light] light rays

of a plurality of wavelengths which are modulated in intensity with a plurality of different frequencies are irradiated on a plurality of irradiation positions on the surface of a living body, and time-variable changes in living body transmitting light intensity levels corresponding to the respective wavelengths and the respective irradiation positions are measured at different positions on the surface of the living body. [After completion of the measurement or during the measurement, changes in concentration values of absorbers in the living body are determined from the living body transmitting light intensity levels of the plurality of wavelengths detected at the respective detection points and a measuring point is set on a perpendicular extending through an intermediate point between the incident point and each detection point so as to image a function of the living body. In living body optical measurement system and method,] Light is utilized to image the results of the measurements, in which the measuring time is shortened by estimating fluctuation attributable to the living body, and the presence or absence of a change in measured signal can be decided easily by displaying an estimation signal and a measured signal at a time. [, and a local change in hemodynamic movement can be measured by detecting light rays transmitting through the interior of the living body by means of two means for light detection disposed at different two sites (equidistant from the light incident point) on a subject and by separating only the local change in hemodynamic movement in the living body in accordance with a logarithmic difference between the two detection signals.]

500.34077CC3

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants: Atsushi MAKI *et al.*

Serial No.: Unassigned (§53b Continuation of 09/203,610 filed 2 December 1998)

Filed: 9 July 2001

For: OPTICAL SYSTEM FOR MEASURING METABOLISM IN A BODY AND IMAGING METHOD

Group: Unassigned (Parent Application AU 3737)

Examiner: Unassigned (Parent Application Examiner E. Mantis Mercader)

LETTER TO THE OFFICIAL DRAFTSPERSON

Assistant Commissioner for Patents
Washington, D.C. 20231
ATTENTION: Ms. Bridget Gray

9 July 2001

Sir:

In the matter of the above-identified application, Applicants hereby submit twenty-one (21) pages of formal drawings for Figures 1-10, 11A, 11B, 12A, 12B, 13-16, 17A, 17B and 18-23.

Approval and entry of the attached formal drawings are courteously solicited.

Respectfully submitted,

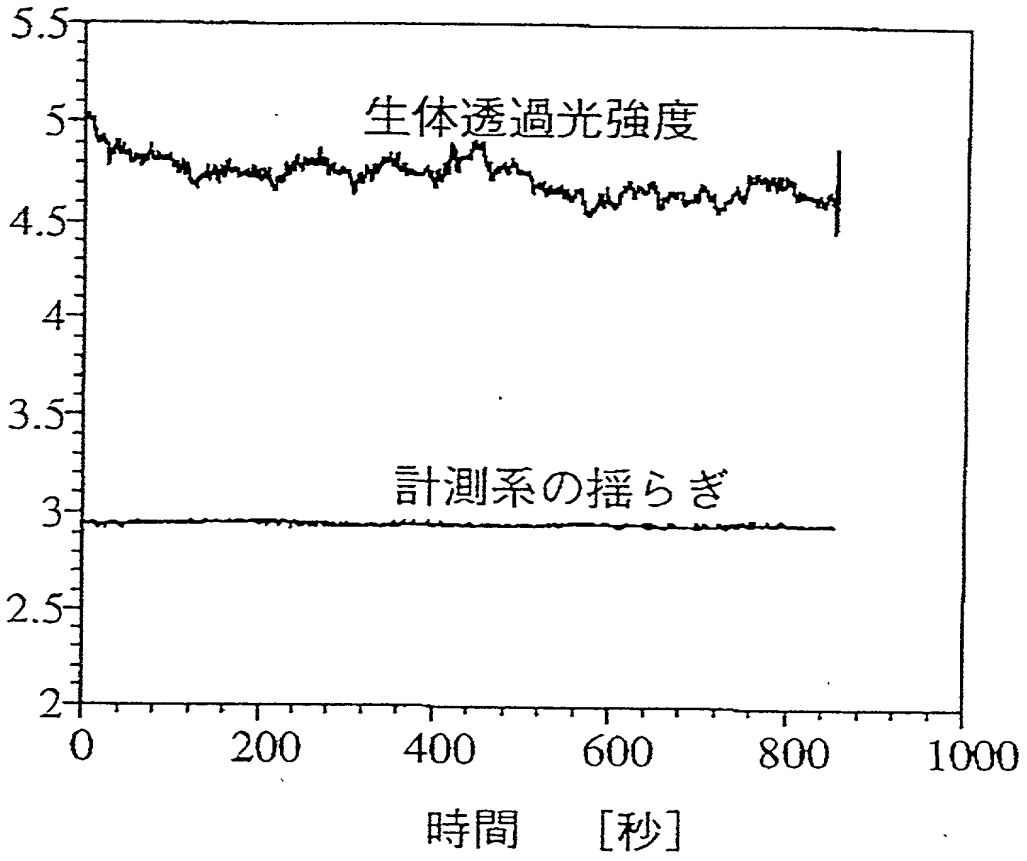
Paul J. Skwierawski, Registration No. 32,173
Carl I. Brundidge, Registration No. 29,621
ANTONELLI, TERRY, STOUT & KRAUS, LLP
1300 North Seventeenth Street, Suite 1800
Arlington, VA 22209
Telephone 703-312-6600
Facsimile 703-312-6666

ATTACHMENTS: Formal Drawings (21 sheets)-FIGs. 1-23

E2063-01

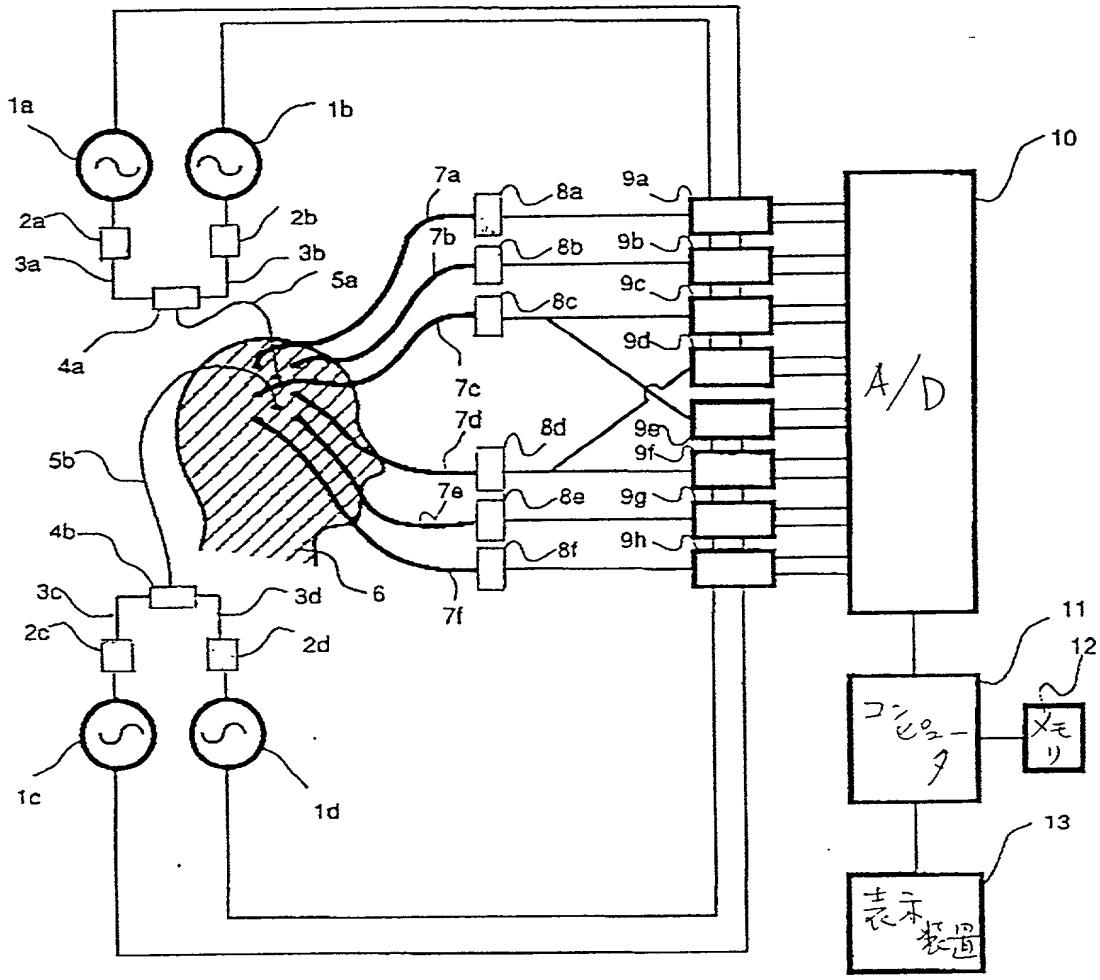
図9

PRIOR ART



透過光強度及び計測系の揺らぎ

図2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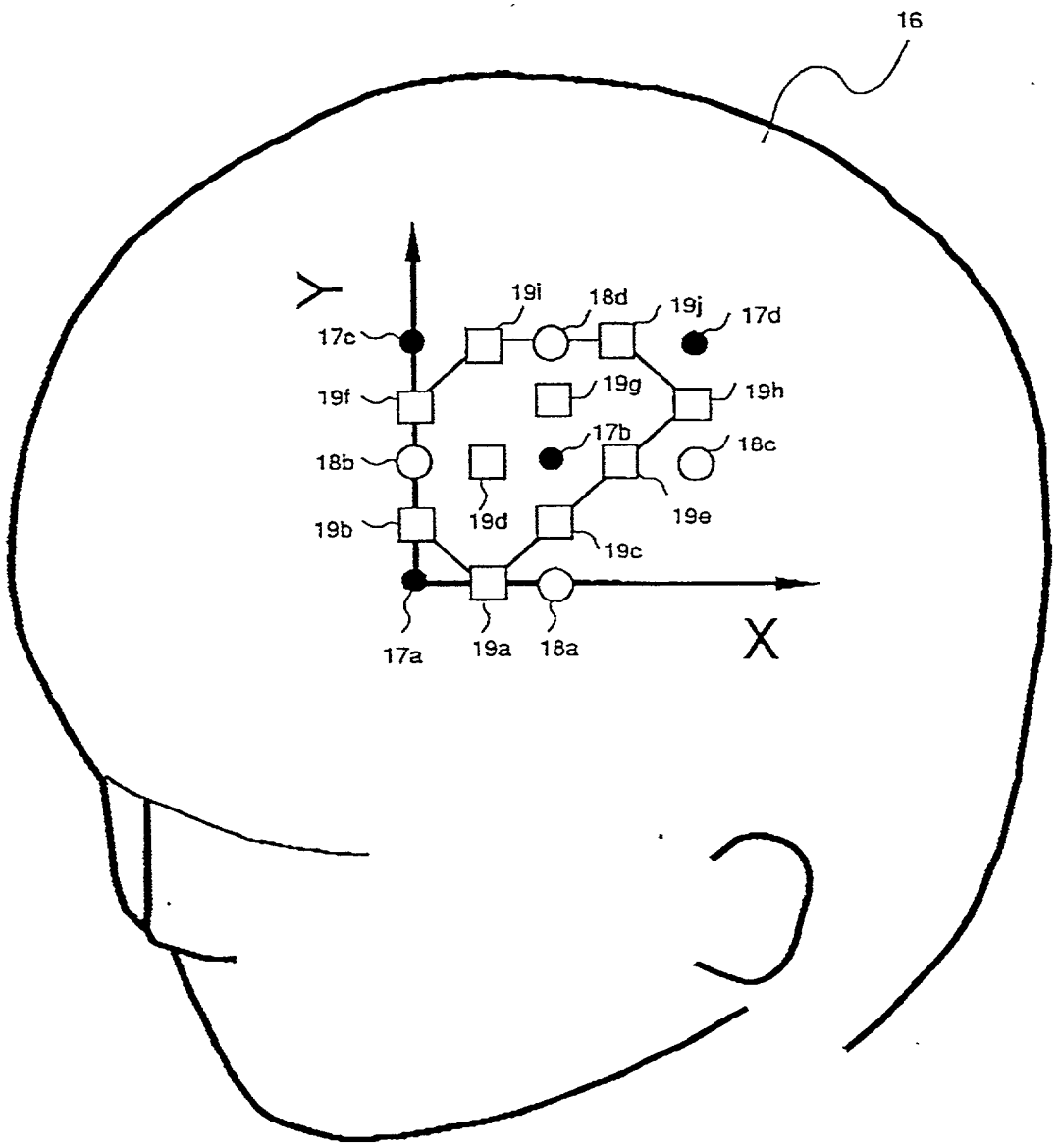
メモリ
13
表示装置

図2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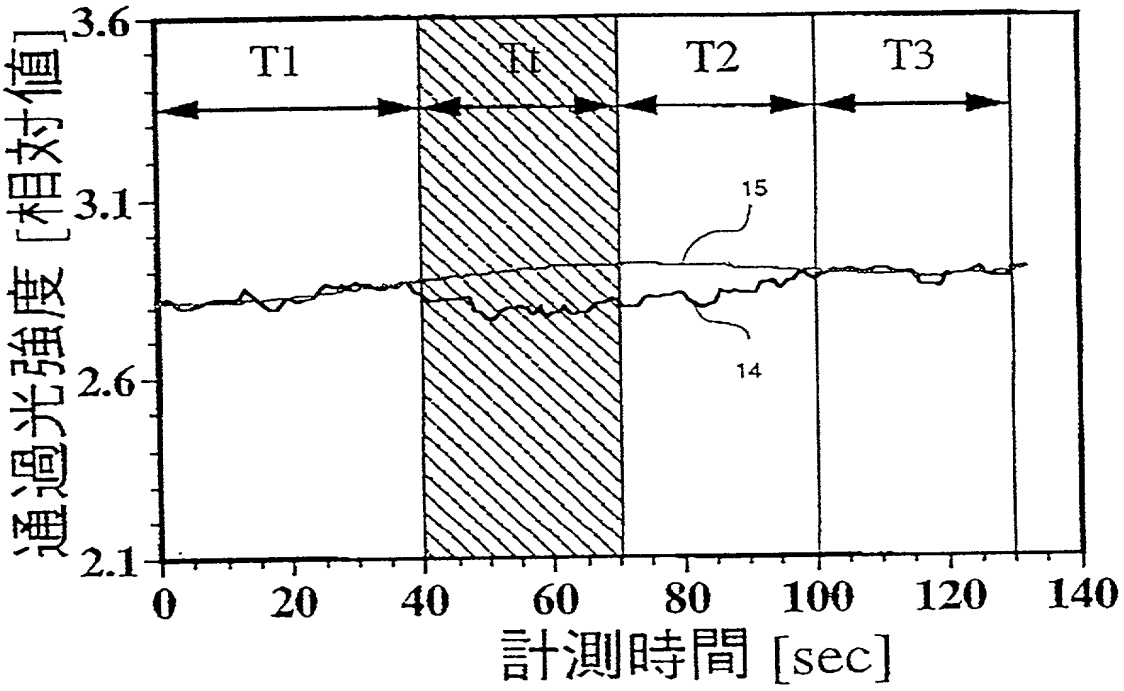
4

図3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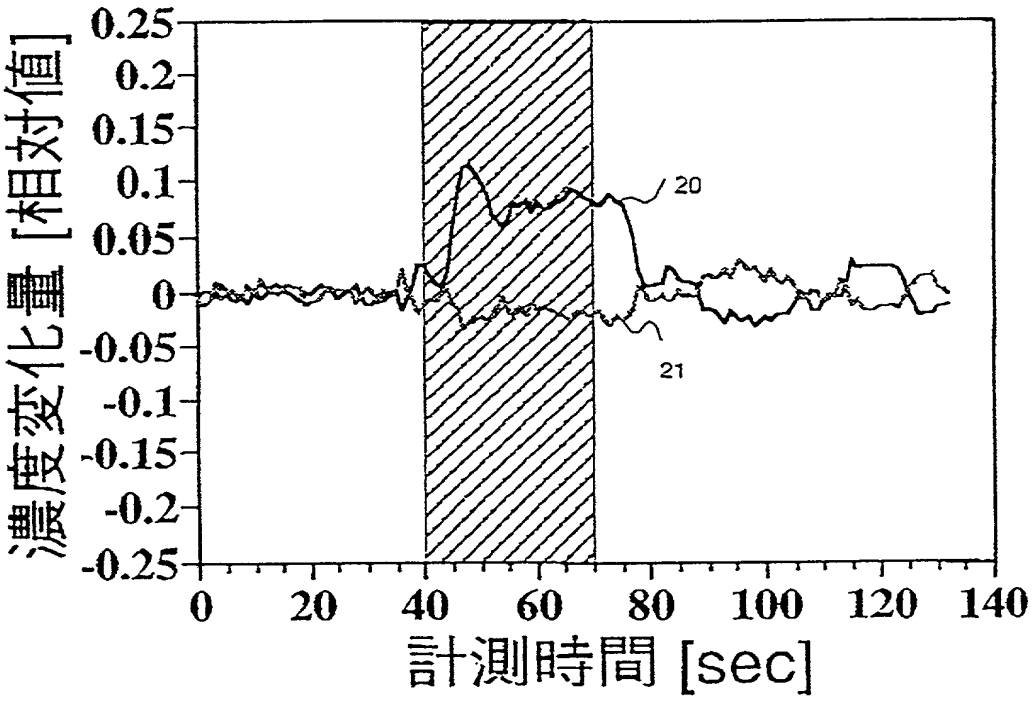
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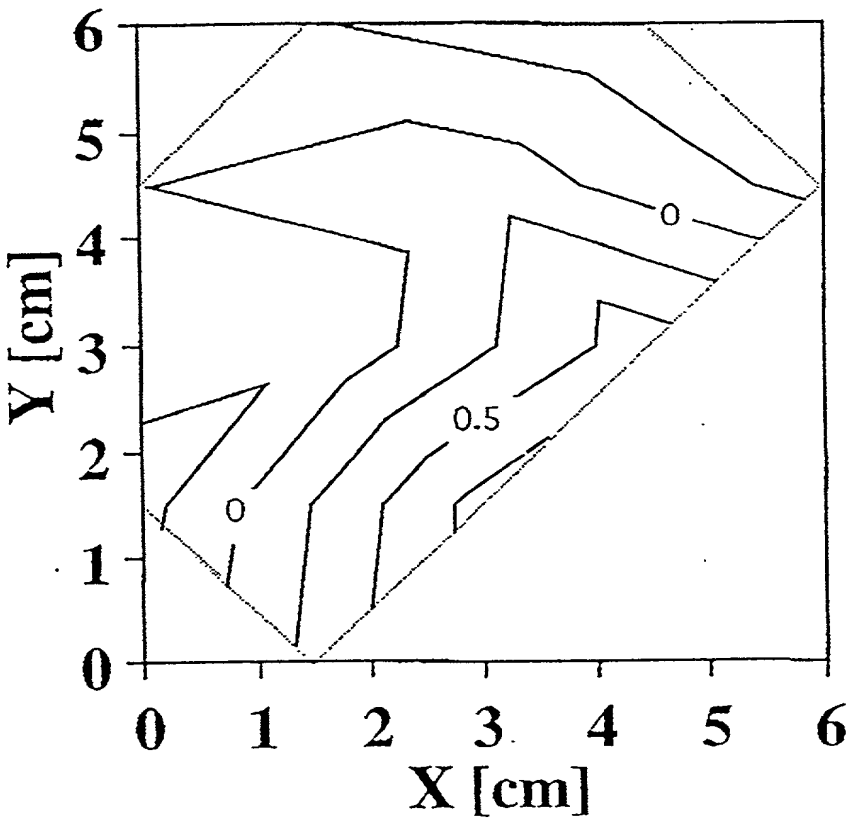
21

6

図5



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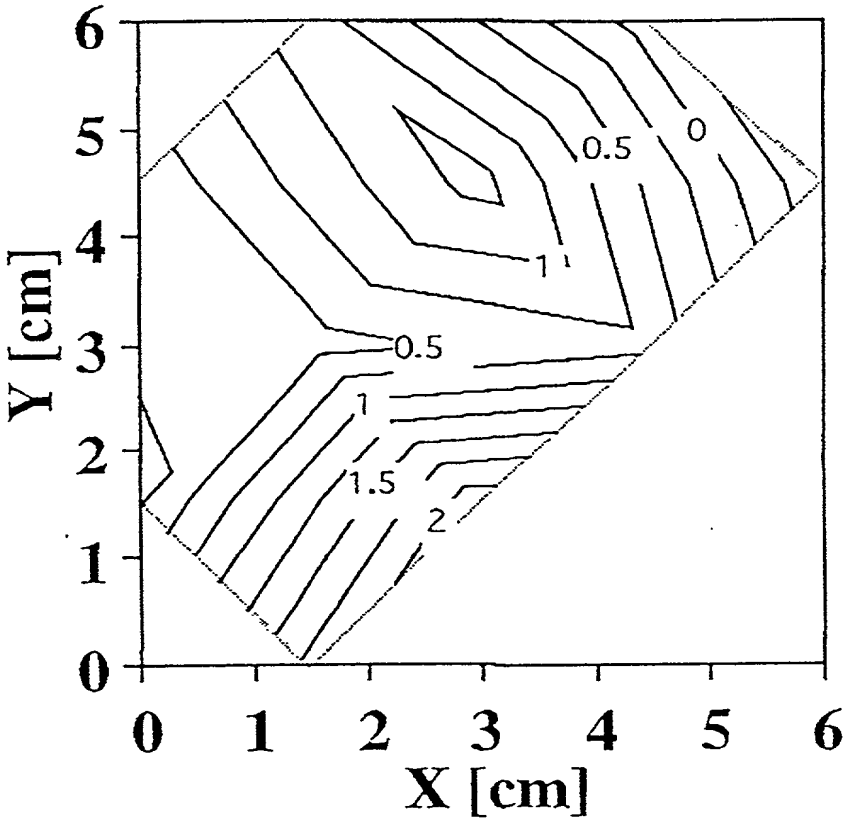

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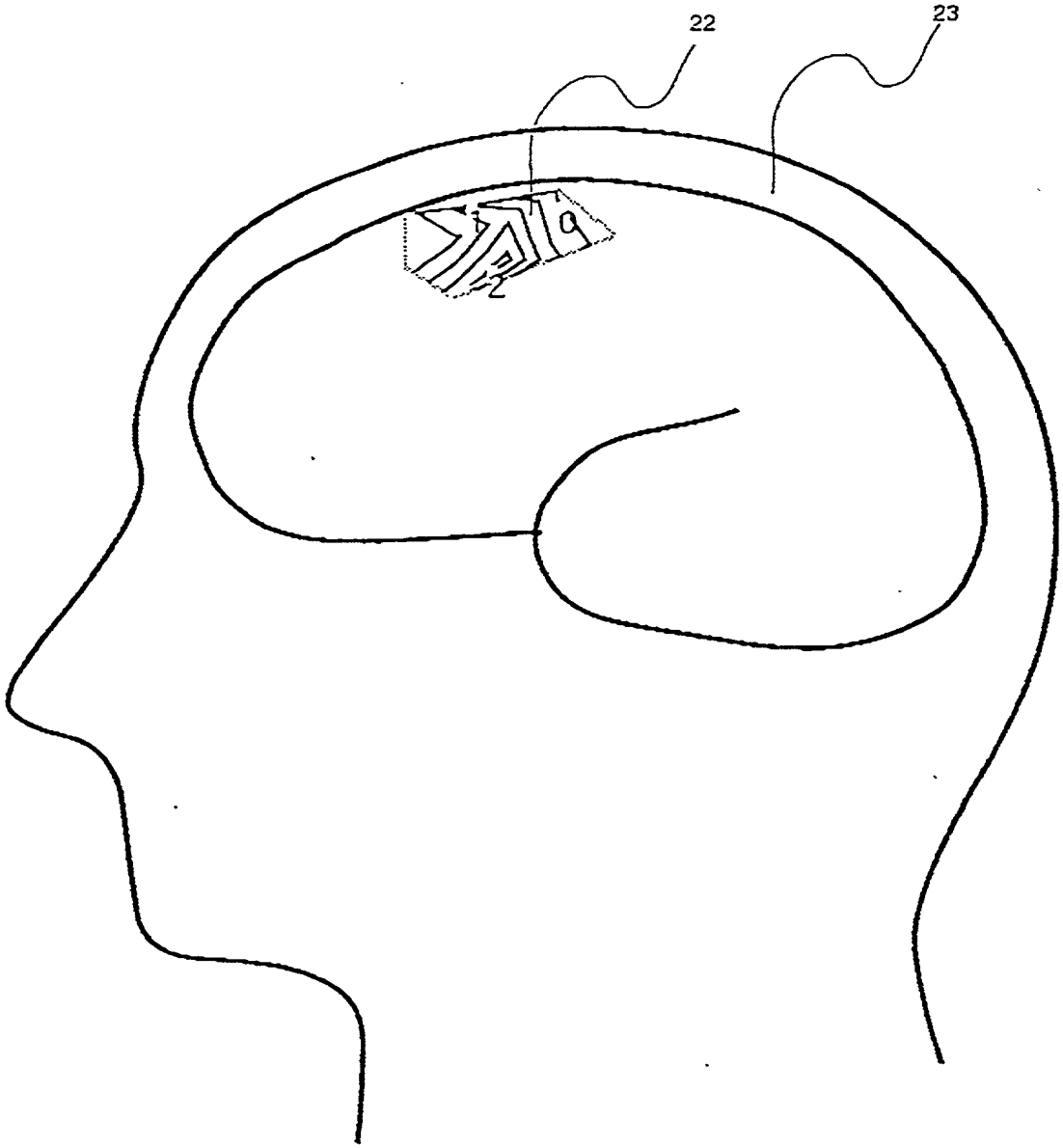

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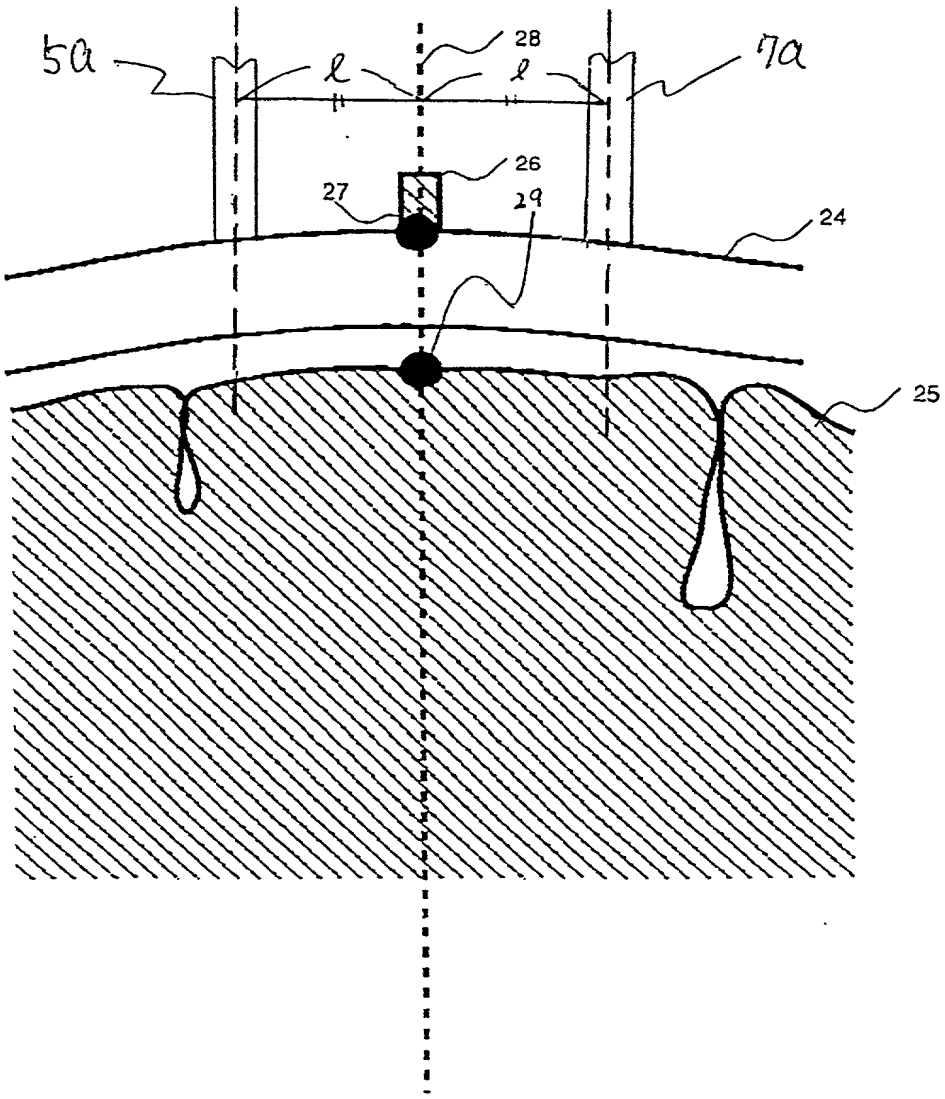

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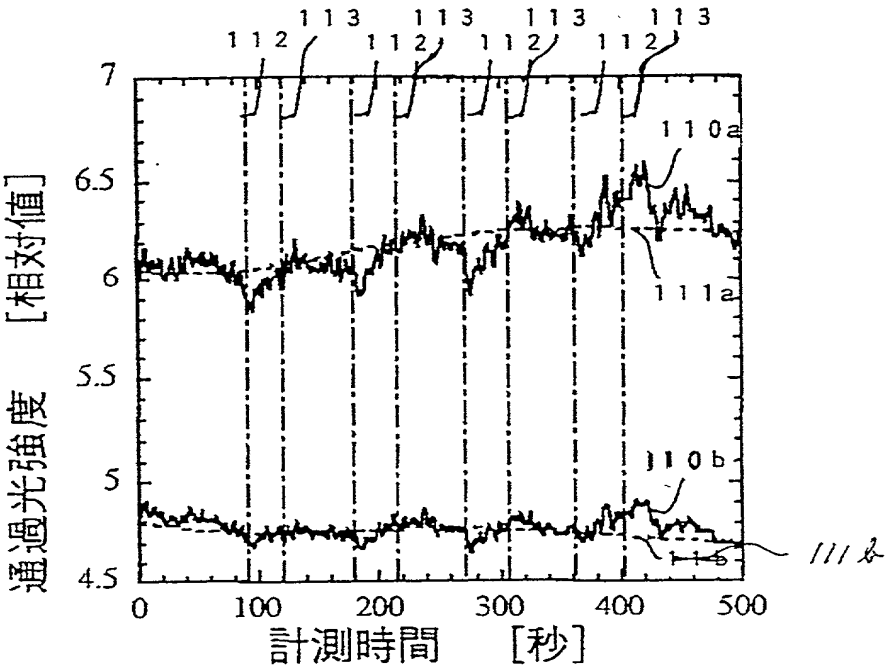
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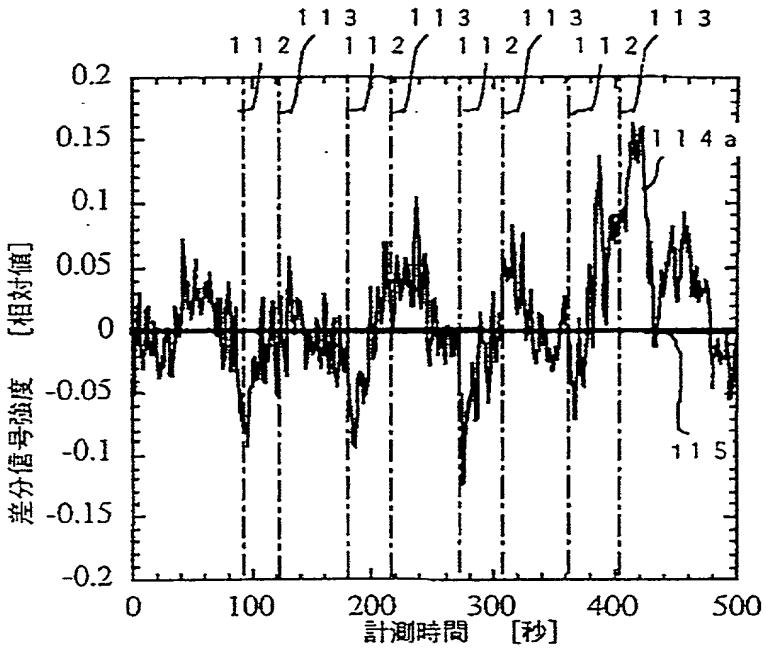
111a
110b
111b

図11

図11A



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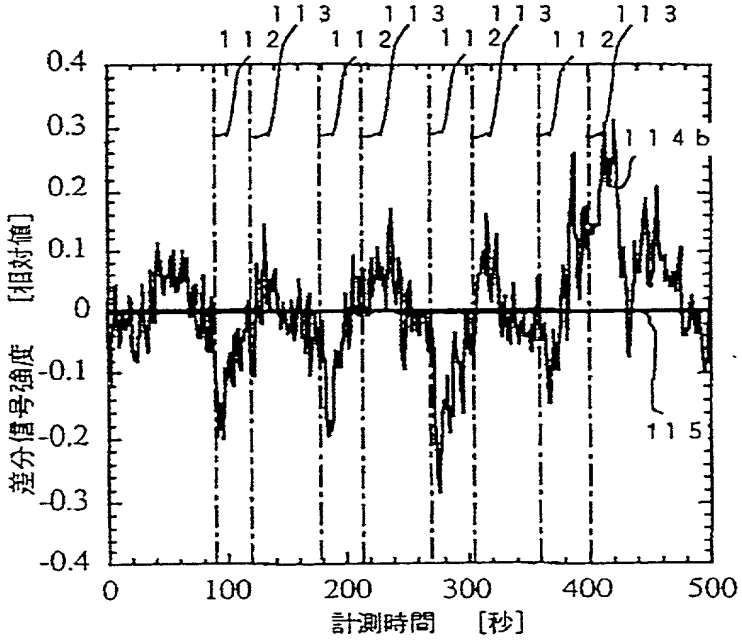
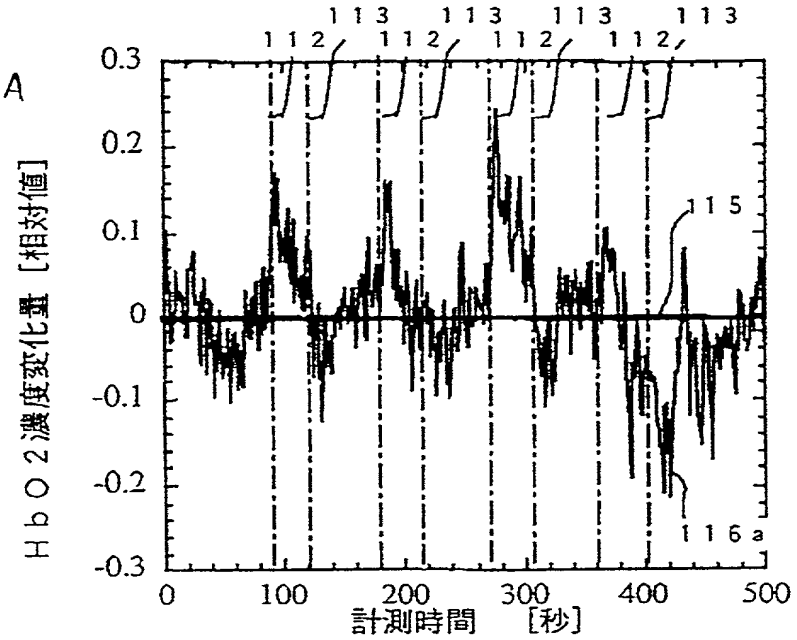


図12

図12A



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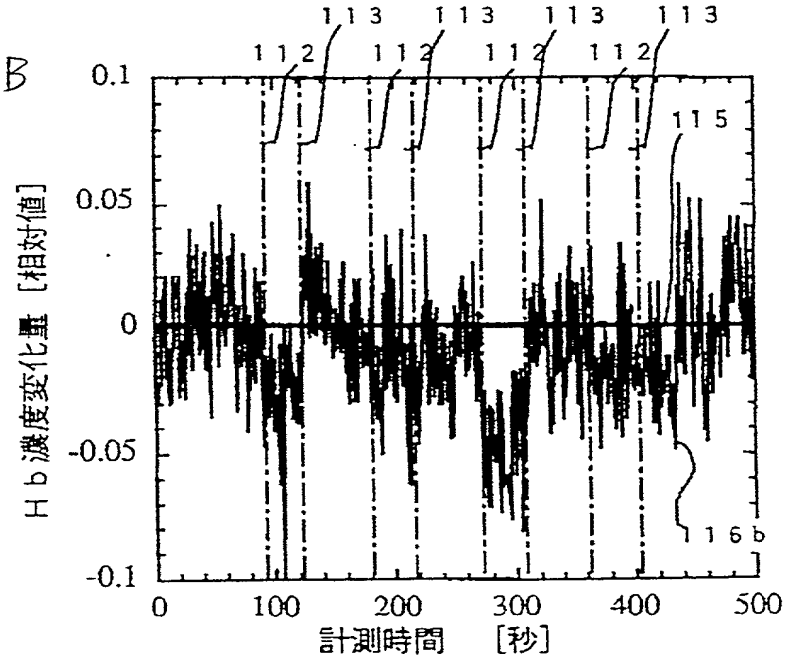

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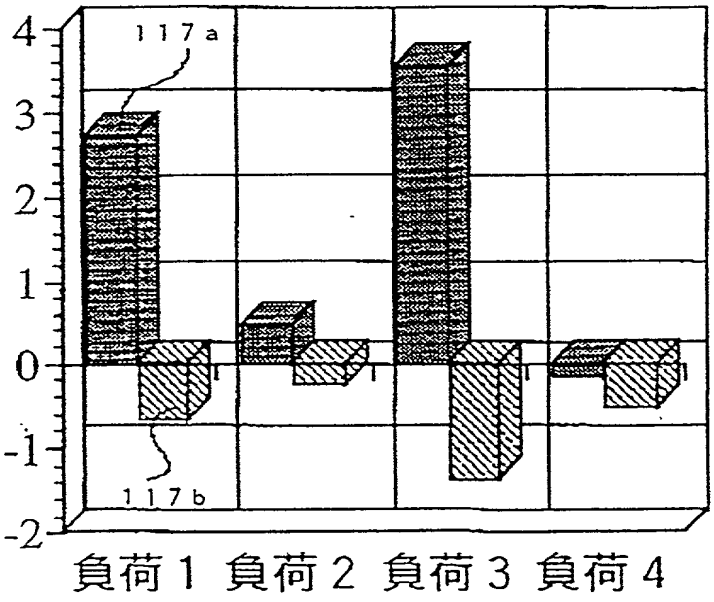

図１４

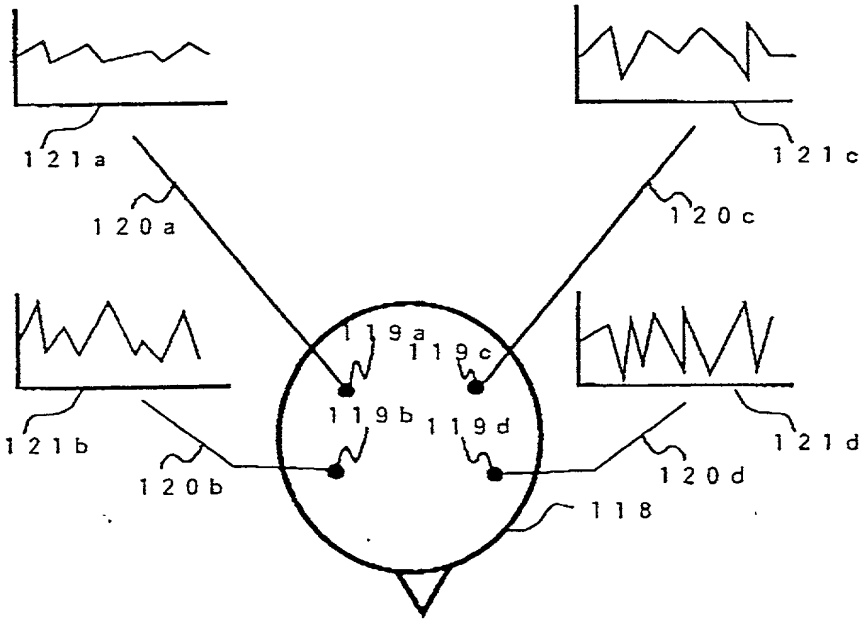
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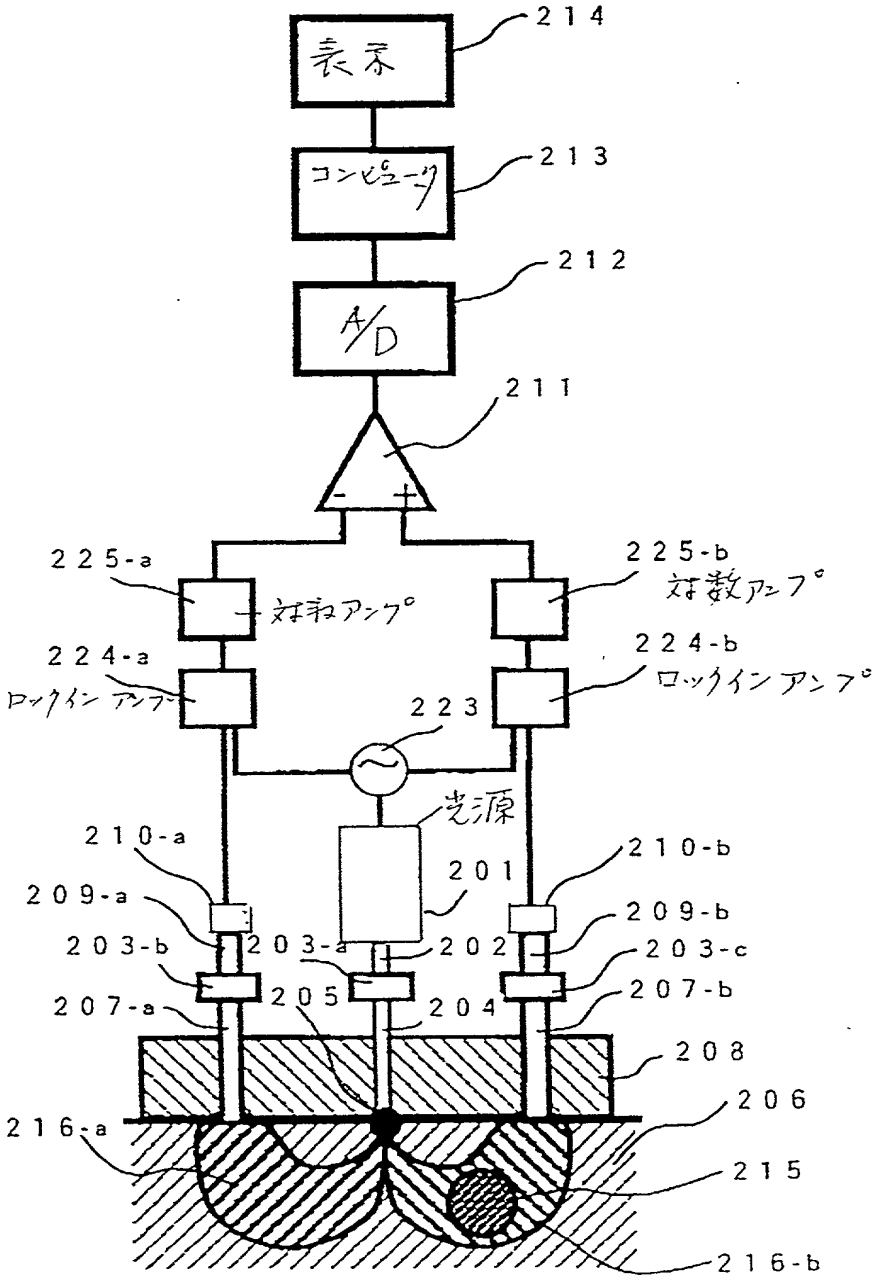
図１５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203-c
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207-b
208
206
216-a
215
216-b

図１６

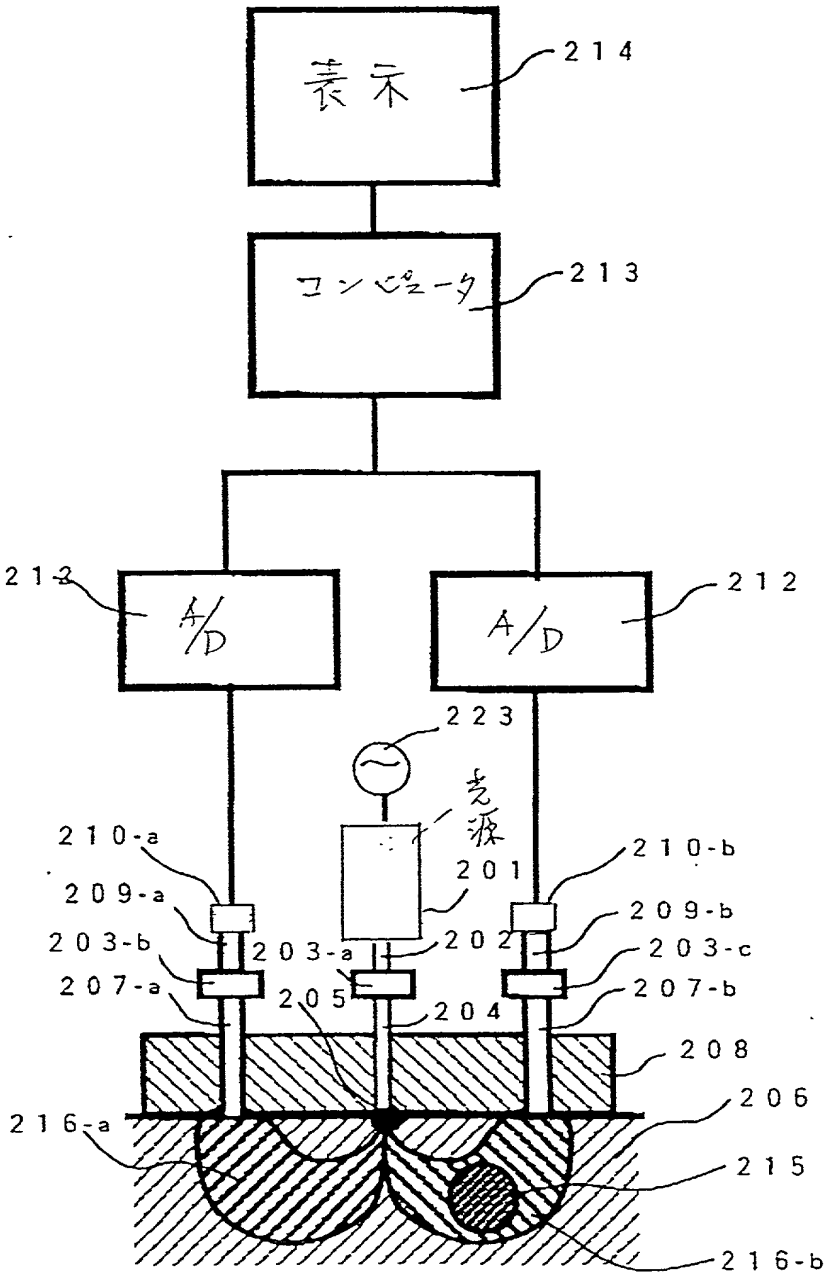

表示
214
コンピュータ
213
A/D
212
A/D
223
光源
201
210-a
210-b
209-a
209-b
203-b
203-a
202
203-c
207-a
205
204
207-b
208
206
216-a
215
216-b

図17

図17A

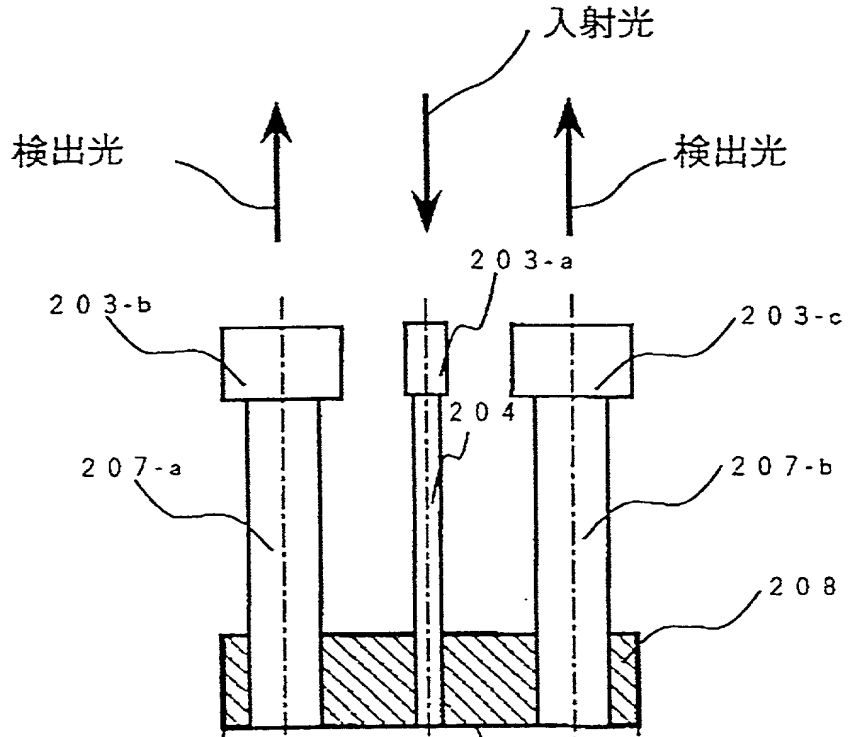


図17B

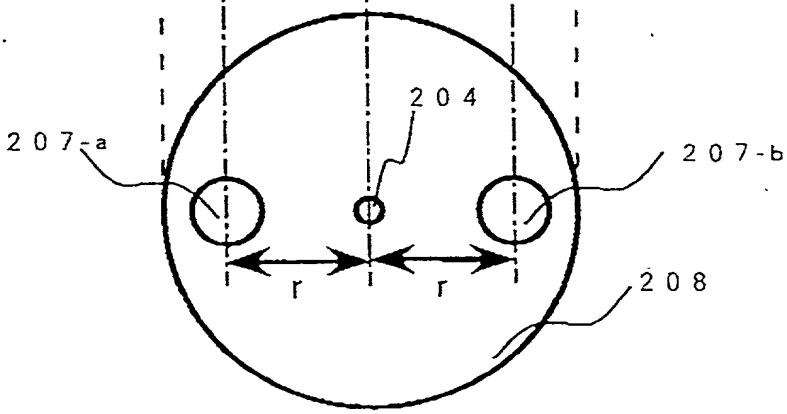


図１８

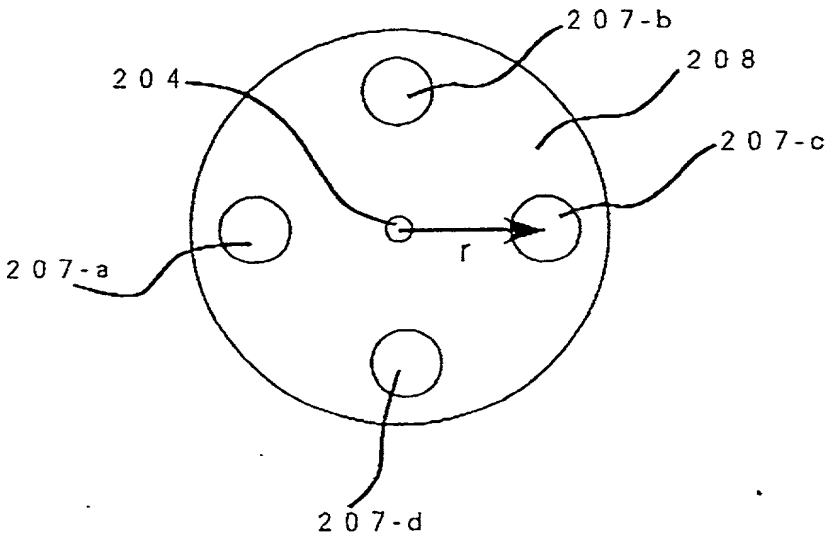


図１９

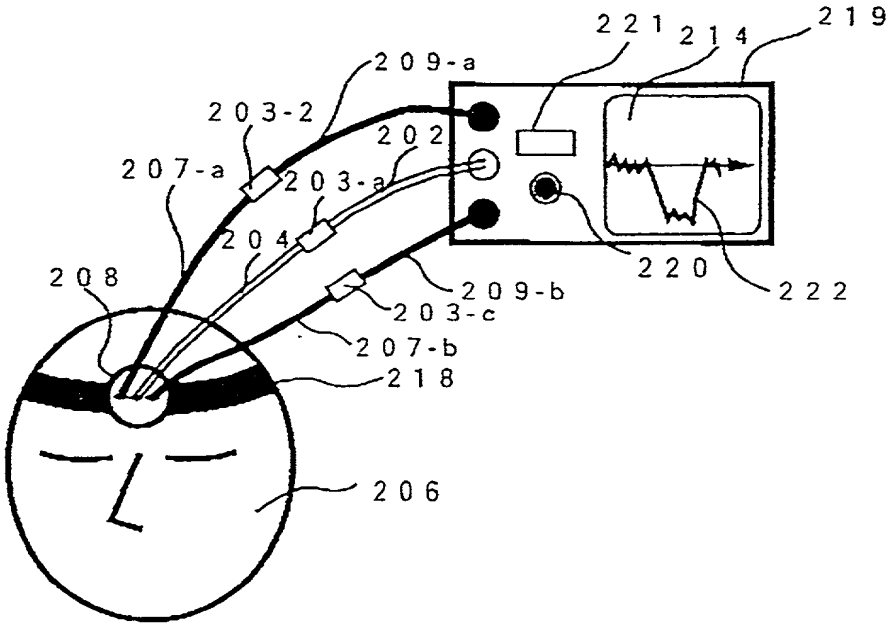

２２１
２１４
２１９
２０９-ａ
２０３-２
２０２
２０７-ａ
２０３-ａ
２０４
２０８
２２０
２２２
２０９-ｂ
２０３-ｃ
２０７-ｂ
２１８
２０６

図２０

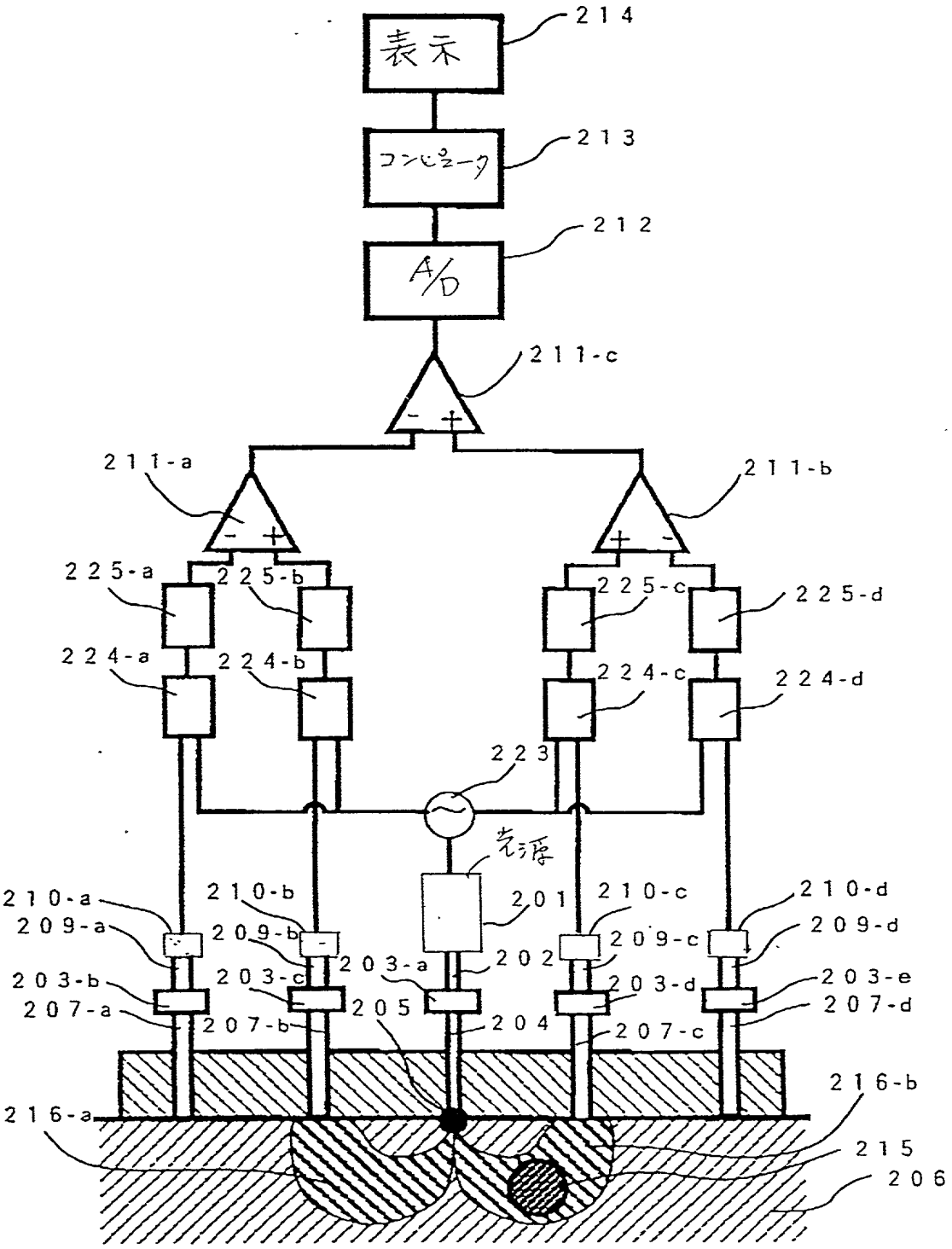
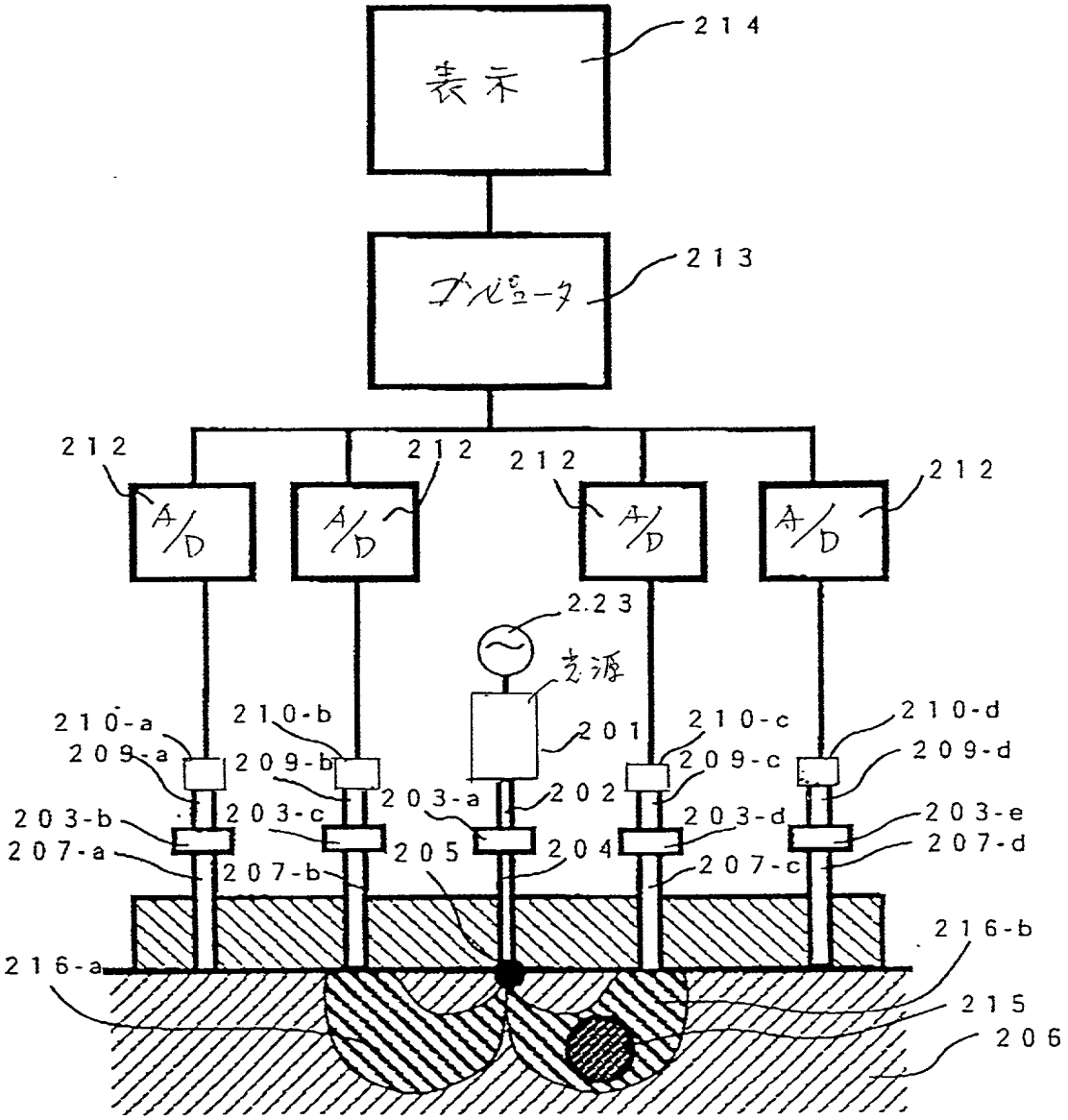

214
表示
213
コンピュータ
212
A/D
211-c
211-a
211-b
225-a
225-b
225-c
225-d
224-a
224-b
224-c
224-d
223
光源
201
210-a
210-b
210-c
210-d
209-a
209-b
209-c
209-d
203-a
202
203-b
203-c
203-d
203-e
207-a
207-b
205
204
207-c
207-d
216-b
216-a
215
206

図２１


表示
214
コンピュータ
213
212
212
212
212
A/D
A/D
A/D
A/D
223
電源
201
210-a
210-b
210-c
210-d
209-a
209-b
209-c
209-d
203-a
202
203-b
203-c
203-d
203-e
207-a
207-b
205
204
207-c
207-d
216-b
216-a
215
206